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PIT 3, 4, 5
BALD EAGLE STUDY

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INTRODUCTION

In the late 1970's it became evident that increased demand for timber, minerals, and recreation posed a potential threat to the Bald Eagle (Haliaeetus leucocephalus) population in portions of the Pit River drainage, Shasta County, California. The US Forest Service needed data on the population to assess impacts of ongoing and proposed activities and to evaluate the application for Federal relicensing of the Pit 3, 4, and 5 hydroelectric projects.

This study was conducted by the Shasta-Trinity National Forests, McCloud Ranger District, with the cooperation of the Lassen National Forest, Hat Creek Ranger District. The Shasta Lake Ranger District (USFS); the California Department of Fish and Game (CDFG), Region I, Redding; the California Department of Parks and Recreation (CDPR), McArthur-Burney Falls State Park; and the Pacific Gas and Electric Company (PG&E) also assisted in this study.

The McCloud District Ranger and the author consulted informally with the US Fish and Wildlife Service (USFWS), Office of Endangered Species, Sacramento, regarding the possible impacts of the research on the species.

Originally planned as a two-year effort, the study was ended after one year due to a combination of administrative changes, funding problems, and realignment of priorities. Data, discussion, and recommendations reported here are intended as a foundation for future research and management of the area's Bald Eagle population.

OBJECTIVES

The objectives of this study were as follows:

1. Define key Bald Eagle habitat use areas - nesting, foraging, and winter roosting.

2. Determine effect of human disturbance levels on Bald Eagle population and, if possible, effect on population dynamics.

3. Determine seasonal Bald Eagle population characteristics - population size, age structure, nesting density, success, and mortality.

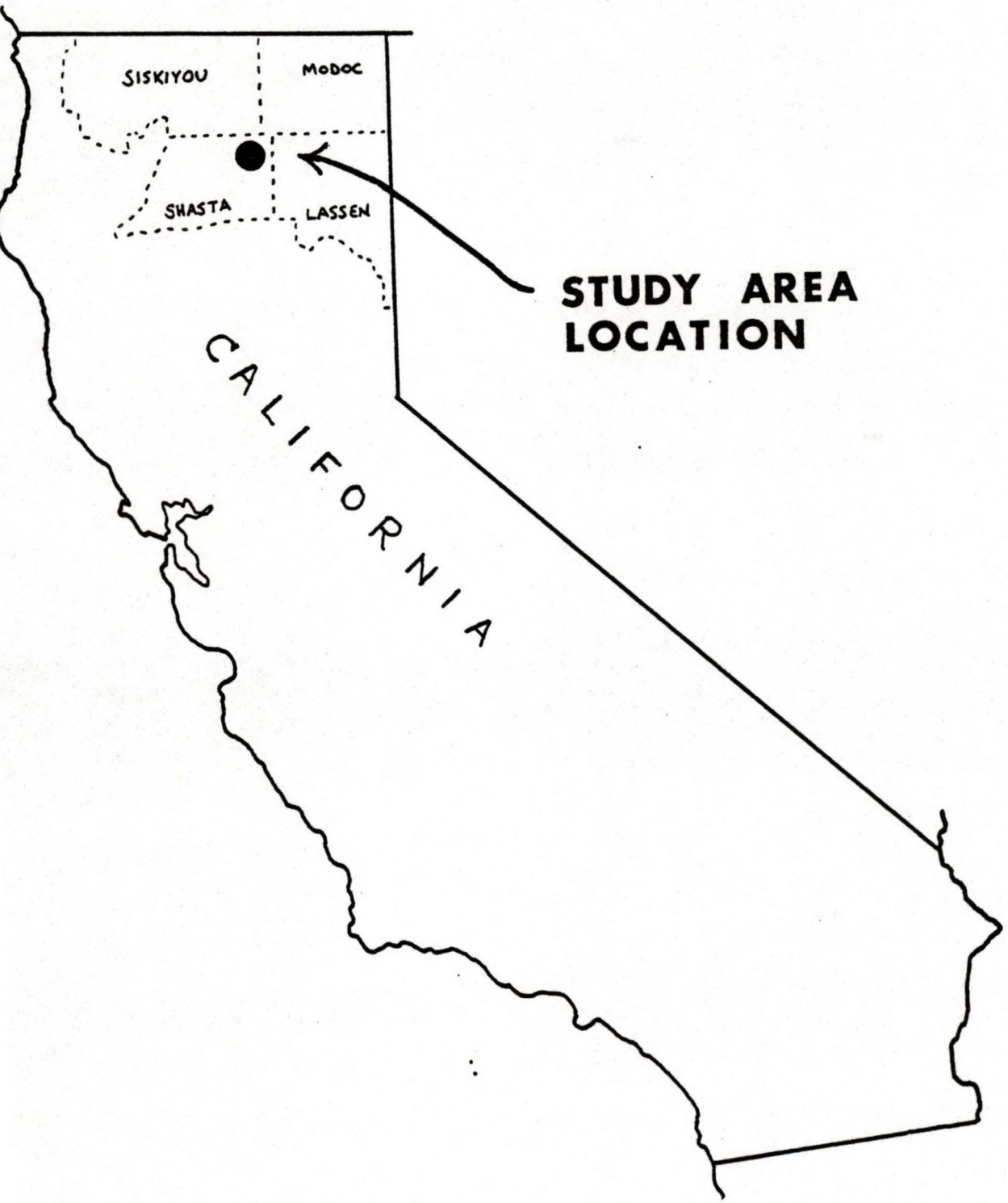
4. Define present and potential essential habitat.

5. Define forage base.

6. Recommend management strategies.

STUDY AREA

The study area lies in northeastern Shasta County, California (Figure 1) where the Pit River traverses the Cascade Range from east to west enroute to its confluence with the McCloud and Sacramento Rivers at Shasta Lake. In a 45 mile (72 km) stretch between Fall River Mills and Shasta Lake, the Pit River has been dammed for hydroelectric generation in five locations.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STUDY AREA
LOCATION
CALIFORNIA

FIG. 1

The study area consists of the Pit 3, 4, and 5 Hydroelectric Projects (Figure 2). These projects include three of the PG&E reservoirs: Pit 3 Dam and its Reservoir, Lake Britton; Pit 4 Dam and Reservoir; and Pit 5-Dam and Reservoir. The river stretches between these reservoirs, and lands extending away from the river and reservoirs for about 1 mile in each direction are also included.

Lake Britton is an impoundment approximately 6 miles (9.7 km) long and 1/2 mile wide at its widest point, with about 1,265 surface acres (512 ha) of water. About 5 miles (8 km) downriver, Pit 4 reservoir is about 1-1/2 miles (2.4 km) long and quite narrow, with about 106 surface acres (43 ha). Another 8 miles downstream lies Pit 5 Reservoir, about 1 mile (1.6 km) long and forming approximately 32 surface acres (13 ha).

Between the reservoirs the Pit River is a free flowing stream characterized by rapids and pools. During the study period, April 1979 to April 1980, flow measured between Pit 4 Reservoir and Pit 5 Reservoir varied from 50 cubic feet per second (cfs) during low water conditions to 18,000 cfs during winter storms. In early 1970, a flow of 31,000 cfs was recorded (Bowers, PG&E, pers. comm.). The streamflow is partially subject to control by the hydroelectric facilities. Through much of the year there is almost no flow in the section from Pit 3 Dam to Rock Creek under present operating procedures.

Elevations within the study area range from 2,050 feet (600 m) above sea level at the surface of Pit 5 Reservoir and 2,770 feet (840 m) at the surface of Lake Britton to 5,880 feet (1,792 m) at the top of Chalk Mountain.

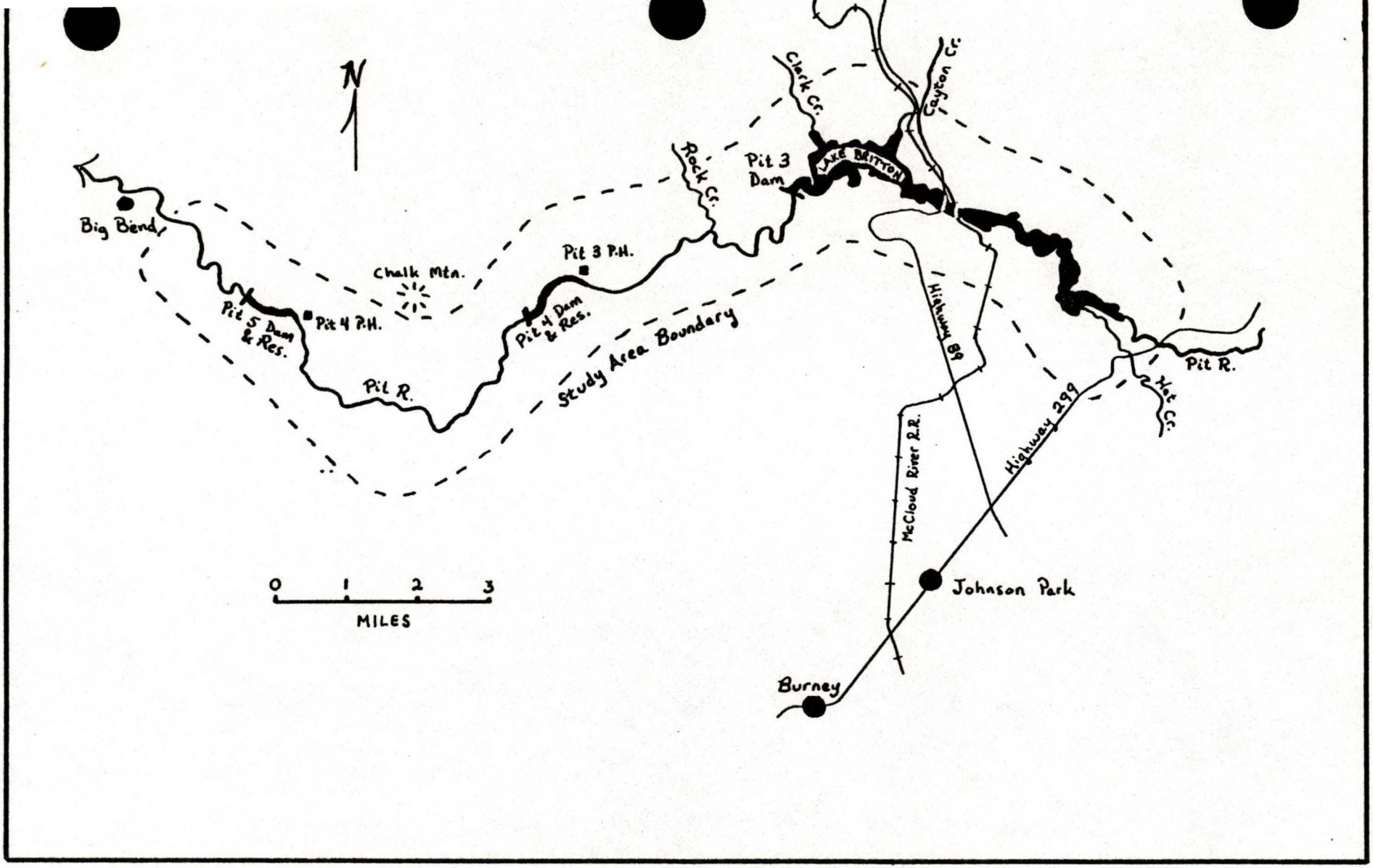
Vegetation of the area consists primarily of ponderosa pine/black oak woodland and mixed coniferous forest. Blue oak, live oak, digger pine, and several brush species are found throughout the area on warm, dry sites. Western juniper is found on the dry eastern portion. Riparian vegetation consisting of alder and willow occurs along the river and its tributaries.

Hot dry summers and cool wet winters with mixed rain and snow describe the climate. Yearly precipitation at McArthur-Burney Falls State Park averages about 30 inches (76.2 cm) per year, including about 30 inches of snowfall. In 1979-80, 43 inches (109 cm) of precipitation was measured, with 46 inches (124.5 cm) of snow.

OWNERSHIP

Most of the land in the study area is owned by the USFS. PG&E is the secondary owner, holding most of the shoreline of Lake Britton and the other reservoirs. Private timber lands include those of Fruit Growers Corporation and Sierra-Pacific. The State of California holds parklands in the area, and there are private lots in several areas around Lake Britton.

At the time this study began, USFS lands west of Highway 89 were administered by the Shasta-Trinity National Forests, McCloud Ranger District. USFS lands east of Highway 89 were administered by the Lassen National Forest, Hat Creek Ranger District. During the spring of 1980, USFS lands above Pit 4 Reservoir, including those around Lake Britton, were transferred to the Lassen National Forest. Currently the entire Lake Britton area and the Pit River - Rock Creek area down to Pit 4 Reservoir is managed by the Hat Creek Ranger District. That portion of the study area including Pit 4 Reservoir and Pit 5 Reservoir is



STUDY AREA

FIG. 2

currently managed by the Shasta-Trinity National Forests, Shasta Lake Ranger District.

METHODS

The history of Bald Eagle use in the study area was constructed from USFS and CDFG records, personal communications with employees of PG&E and CDPR, and from unpublished data in the files of American Birds.

This report covers the period March 1979 through June 1980, including two reproductive seasons. This was made possible by personnel of the cooperating agencies, whose observation reports cover periods before and after the author's field work.

The primary field work for this study was conducted from mid-April 1979 to late March 1980. During this period the author spent about 455 hours on the study area. No field work was conducted during the following periods: second and fourth weeks of June, last half of August, September, and the first half of November, 1979. Field work during the first three months of 1980 was accomplished primarily on weekends.

Through exploration of the study area, a series of observation points were established around Lake Britton and the downstream reservoirs. Observations were made with 9x35 binoculars and a 15-60X variable-power spotting scope. All observations were recorded in field notebooks. By using these points in sequence, all of the nests and most of the shoreline in the study area could be observed and the number of eagles present determined. Most of these points were accessible by vehicle, although during the winter those around the eastern secton of Lake Britton were often accessible only by foot.

One fixed-wing aircraft flight and one helicopter flight were made to attempt censusing and to record eagle reaction to aircraft.

No eagles were captured, banded, or marked, and no nests were entered. Identification of adult pairs was made on the basis of location and observed behavior. Identifying characteristics such as plumage variations, stage of molt, and in one case a distinctive voice were used to identify individual eagles. Sex of individual birds was sometimes distinguished by size, and relative beak size in familiar pairs. Immature eagles were assigned to age classes as defined by Southern (1967).

An extensive literature review was completed on the subject of human disturbance, and concurrent university course work by the author provided the opportunity to study population dynamics.

GLOSSARY

Terminology used in this report is defined as:

Essential Habitat - Habitat believed essential for species survival, based on observation of use areas.

Fledgling - A bird at the age of its first flight.

Immature - An eagle less than 4 years old, as per Southern (1967).

Primary Zone - A delineated management zone around a Bald Eagle nest which represents the key area of activity based on behavior observations. This zone may be surrounded by a "secondary zone" or buffer.

Occupied Territory - Refers to any nesting territory where birds have been seen during the nesting season.

Active Territory - A territory where nesting attempt took place.

RESULTS

KEY TO TERRITORIES

References to particular nest territories are by territory number, after the numbers assigned to Shasta County nest territories by Lehman (1980). Territories are designated as follows:

Pit Rim (Pit 4 Reservoir):	08
S. Shore (Lake Britton):	09
N. Shore (Lake Britton):	10
Dry Lakes (Lake Britton):	14
Hagen Flat (Pit 5 Reservoir):	15
Clark Creek Road (Lake Britton):	19
Two Knobs (Lake Britton):	28
Cayton Creek (Lake Britton):	29*

*Number unassigned by Lehman 1980

HISTORY

Historically the Bald Eagle was found statewide in California, both as a breeding species and as a winter visitor (Small 1974, Lehman and Detrich 1979). Today 700 to 800 eagles still occur statewide during winter (Detrich 1980), while the state's breeding population has declined to less than 50 known pairs, all in the northern one-third of the state (Lehman and Detrich 1979).

Given the species' ecological requirements it may be assumed that breeding and wintering Bald Eagles have occupied the Pit River drainage for centuries. Logging and agriculture in the late 1800's may have had some effect on the species, but the most significant changes have been more recent.

Within the last 60 years, historic Bald Eagle habitat in Pit River area has been extensively modified by reservoir construction, elimination of anadromous fish runs, and changes in populations of warmwater fish species.

Pit 3 and 4 hydroelectric developments were completed in 1925 and 1927. Pit 5 was completed in 1943. Shasta Dam, fifty miles (80.5 km) downstream, was completed in 1944, and several smaller reservoirs have subsequently been constructed on the Pit River system (Cal. DWR 1976).

Nothing is known of the process by which Bald Eagles adjusted to this modified habitat. They were not included in a list of avian species at the state park in

the 1930's. The earliest written nesting record found was from territory 09 in 1959. In the late 1960's and early 1970's production began to be recorded on known nests, and in the mid and late 1970's more nests were located, recorded, and the wintering population documented.

In 1974, Bald Eagle nest construction (territory 19) near the intersection of a logging road, a county road, and a railroad track focused attention on this population. This nest was abandoned after several years of unsuccessful occupancy. Since that time there have been recurring problems involving land management practices and Bald Eagles.

The Bald Eagle is presently listed as an Endangered Species under Federal and California law. Concern for this species centers around the possible impacts resulting from land management and recreation activities. The Lake Britton area is currently a focal point for various resource uses, some of which could have negative effects on the Bald Eagle population and habitat. These resource uses are discussed below to establish background for this study. Conflicts observed between resource uses and eagles and Bald Eagle behavior relating to resource management are presented in the Results and Discussion sections.

Recreation

Lake Britton is a popular recreation area. McArthur-Burney Falls State Park, near the lake's southwest end, provides camping, swimming, and boating facilities and attracted about 190,000 visitors in 1979. PG&E and the US Forest Service each maintain one campground on the north shoreline. PG&E also maintains a picnic ground and boat launch near the Highway 89 bridge, and a small boat launch near the east end of the lake. Water skiing, fishing, and waterfowl and small game hunting are popular seasonal sports. "Plinking" is a year-round activity. Off-road vehicles, including four-wheel drive and motorcycles use the area extensively.

Recreation in the area below Lake Britton is limited by the terrain. Some fishing and hunting occurs on the river and from the shoreline of the reservoirs. Boats are currently prohibited on Pit 4 and Pit 5 Reservoirs by county ordinance.

Timber Management

Logging has historically been a major source of the Region's economy. The Hat Creek Ranger District (USFS) and PG&E have recently conducted salvage timber operations near Lake Britton, and a timber sale at the lake's northeast end is currently being planned by the Hat Creek Ranger District.

Logging in the canyon below Lake Britton has been restricted by steep terrain. The Hat Creek Ranger District is currently planning a sale on the souuth side of the canyon. A PG&E logging operation was conducted in a Bald Eagle territory near Pit 5 Reservoir in the mid-1970's.

Mining

The Lake Britton area is underlain by deposits of diatomaceous earth, a commercially valuable mineral. There are several abandoned diatomaceous earth operations in the area. Grefco mining company owns a 240 acre (97 ha.) site 1/2

mile (.8 km) west of Lake Britton which is largely unexploited. In 1977, the McCloud River Railroad applied to the US Forest Service to build a spur railroad from the Grefco property to the main railroad line near Highway 89. This application was denied by the Shasta-Trinity National Forests Supervisor and the Regional Forester, and is currently under review by the Chief of the US Forest Service in Washington, DC. Denials have been on the grounds that the railroad could result in a negative effect on Bald Eagle nest territories 10 and 29. One alternative is to haul material by truck over existing County roads.

The American Resources and Refining Company has filed several claims on diatomaceous earth deposits near Lake Britton on Forest Service lands both east and west of Highway 89. No development has yet taken place.

Residential Development

There are several private residences in the Clark Creek area of Lake Britton. Just east of Cayton Creek there are also several private lots, and one home was constructed there in 1979. Both of these private areas border important Bald Eagle forage zones.

POPULATION

The known history of the Bald Eagle nest territories in the study area is summarized in Figure 3.

Adults

Three occupied nest territories (09, 10, 14) were known at Lake Britton and one each at Pit 4 Reservoir (08) and Pit 5 Reservoir (15) at the beginning of the study. During the study, two more occupied territories were discovered at Lake Britton. One of these (29) had earlier been regarded as an alternate to a known territory (10).

A total of seven pairs now occupy the study area. This constitutes about 16% of the occupied Bald Eagle territories known in California (Lehman and Detrich 1979). The Lake Britton population has the highest nesting density in the state (Lehman 1979), with five occupied nests separated by distances ranging from .66 mile (1.1 km) to 2.3 miles (3.7 km), with a mean distance of 1.44 miles (2.3 km).

Previous reports indicate that the Bald Eagle population on the study area is at least partially resident throughout much of the year (Kahle 1976, Detrich 1978, 1980). The findings of this study confirmed that conclusion.

In 1979, adult eagles were known to be present in six of the seven territories from the beginning of observations in March through the month of December. Adults remained on three territories where young were not produced, as well as on the three territories where young were raised. The seventh pair disappeared in May after nesting failed in April. No eagles were seen in that territory until the following December. A pair was present there by January 1980, and all seven pairs were then present at least until April 1980. No particular fluctuation was noted in the wintering population of adults.

FIGURE 3
HISTORY OF BALD EAGLE NEST TERRITORIES - PIT 3, 4, 5 AREA

Year --> Territory ↓	Pre-1969	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
NORTH SHORE #10		1 Young Nest #A	1 Young Nest #A	2 Young Nest #A	2 Young Nest #A	0 Young, Adult shot in Nest #A		Nest #B Discovered, failed during incubation	Failed in Nest #B, possible disturbance	1 Young Nest #B	1 Adult seen at nest, no known attempt	Incubated and failed, possible disturbance	Pair present, incubation uncertain, no young
CLARK CREEK ROAD #19							Adults observed in nest construction	Adults present, attempt unknown	Incubated and failed, possible disturbance	----------No Known Activity---------->		Nest destroyed	
CAYTON CREEK #29											Discovered during incubation, 2 Young	Attempt unknown. Adult found dead below nest, cause unknown	2 Young
SOUTH SHORE (State Park) #09	Produced 2 young Nest #A 1959	(Eagles were present around nest this period --- No production recorded)					No nesting attempt	-------Eagles Present-------> in area, nest location unknown			Nest #B discovered	Incubated and failed Nest #B, possible disturbance	Incubated and failed Nest #B
DRY LAKES #14								2 Young Nest #A	2 Young Nest #C	1 Young Nest #C	1 Young Nest #A	1 Young Nest #C	Pair present, incubation uncertain, no young
TWO KNOBS #28										(Size of Nest indicates several years occupation)		Discovered 5/79, 2 Young	2 Young
PIT RIM (Pit 4 Res.) #08		(Resident reports a nest was present and produced young during this period)			(Eagle activity known in area, nest location unknown)			Nest #A & B discovered	(Eagle activity known in area, nesting attempts unknown)			Nest #C discovered, 1 Young	1 Young
HAGEN FLAT (Pit 5 Res.) #15						Nest discovered, 1 Young	1 Young, territory logged	Incubated and failed	3 Young	2 Young	Incubated and failed	Incubated and failed after hatch	2 Young

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Immatures

Bald Eagles do not attain their distinctive adult plumage and sexual maturity until the age of five or six years (Southern 1967). Immatures of various age classes were present in the study area during all months of observation.

At Lake Britton no clear pattern of seasonal variance was noted in the immature population. Most sightings were of single birds, but seven immatures were observed together in June and three in December.

At Pit 4 Reservoir, where a winter concentration of Bald Eagles has been documented in the past (Kahle 1976, Detrich 1978), no immatures were observed during the period April through October 1979. In late November, immature eagles began congregating and their number increased until mid-February 1980, when a minimum of 16 birds were seen. This group broke up in early March.

No immatures were seen at Pit 5 Reservoir during the study, although they have occasionally been seen there in the past. Resident adults may dominate the limited forage sources there.

Age Ratios

The age ratio of the group seen at Lake Britton in June 1979 was: 1 three-year-old (hatched 1976), 3 two-year-olds (hatched 1977), and 3 one-year-olds (hatched 1978). The age ratio of the group seen at Pit 4 Reservoir in February 1980 was 1 hatched 1976, 8 hatched 1977, 4 hatched 1978, and 3 first-year (hatched 1979). A year of high reproduction on the study area and at nearby Shasta Lake was 1977. It is unknown whether these immatures were produced on the area or were dispersals from other territories.

REPRODUCTION

Bald Eagle reproduction on the study area is summarized in Table 1. The increasing number of known locations is believed to be largely a result of continued search efforts rather than an expanding population.

TABLE 1
BALD EAGLE REPRODUCTION
PIT 3, 4, AND 5 AREA

Year	Known Occupied Nesting Locations	Known Attempts	Successful Attempts	Number of Young	Young Per Attempt	Young Per Successful Attempt
1973	2	2	1	1	.5	1.0
1974	2	1	1	1	1.0	1.0
1975	4	3	1	2	.67	2.0
1976	4	4	2	5	1.25	2.5
1977	3	3	3	4	1.33	1.33
1978	4	3	2	3	1.0	1.5
1979	7	6	3	4	.67	1.33
1980	7	7	4	7	1.0	1.75
Total				27	Mean .82	

Reproduction on the study area in 1979 was compared statistically with reproduction for the entire state in the same year. No significant difference was found. (Mann-Whitney test: U=105, U'=135, both less than critical value of 161 [Zar 1972].)

MORTALITY AND REPLACEMENT

Without an understanding of mortality rates and factors, known reproductive rates have only limited meaning (Grier 1979, 1980). Nothing is known of survival rates in the California Bald Eagle population, and very little data could be found for the species.

One case of adult mortality was discovered at Lake Britton in 1979. Laboratory tests on the carcass could not determine cause of death or age.

It is known that this adult was replaced by another adult, and the ensuing pair reproduced successfully in 1980.

NESTING CHRONOLOGY

Adult Bald Eagles were observed in the primary zones of the Lake Britton territories during every month of observation. Adults were observed in or on the nest during every month from November through July in territory 29.

Exact dates of incubation are unknown. Judging from estimated hatching dates and behavior (male in nest, female in nest for prolonged time, etc.) incubation probably originated in early March 1980.

The period of fledging and post-fledging parental care has received little study in California. The earliest date a juvenile was seen off the nest at Lake Britton was June 17, 1979 (territory 14). At the second successful nest (18) no young were seen off the nest until after July 5.

Juveniles were observed in the primary zone up to one month after fledging and they were seen following adults for about the same period. It is not known how long the juveniles remained before dispersing, but no first-year birds were seen when observations resumed in October and November.

ESSENTIAL HABITAT

Nesting

The silvicultural characteristics of Bald Eagle nest habitat in California have been described by Lehman (1979, 1980). Bald Eagles nest only in large old ponderosa pines on the study area. Present and potential nesting habitat was analyzed by the Hat Creek Ranger District in two contiguous nesting territories (14 & 28). A Bald Eagle habitat management unit has been created for territories 14 and 28 in which timber will be managed for long-term maintenance of suitable nesting habitat. Subjectively, timber suitable for future nest habitat is limited in several areas, especially in territory 10. Recreation areas, especially the State park and North Shore Campground, limit future habitat even outside their boundaries. Some present and future habitat is part of private forest lands, where there is little impetus for habitat management. Other proposed uses could also restrict suitable future nesting habitat.

Perching

About 85 different perching locations (not including nest trees) were observed and mapped at Lake Britton. Forty-four (52%) of these received regular use by Bald Eagles. Preferred trees included one to three trees near the nest and six to ten foraging perches per territory.

Trees with repeated perching use included ponderosa pine and Douglas-fir of all ages from young to snags, and black oaks. Location and visibility appeared more important than tree species.

A map of perch locations and other essential habitat has been supplied to the Hat Creek District Biologist (USFS) and the Shasta Unit Biologist (CDFG).

Winter Night Roosting

Night roosting regularly took place within the primary zones of territories 09 and 29 in the months of November, December, January, and February. The exact night roost location was not discovered in territory 09. In territory 29 the birds used two different groves of old-growth ponderosa pine, one near the nest and one about 600 yards (550 m) away. It is not known if this behavior applies to other territories in the study area.

In December 1979, Bald Eagles were observed night roosting less than 1/4 mile (.4 km) from the proposed Grefco rail route in the Cayton Creek area.

No night roost was discovered in the Pit 4 Reservoir area, although such behavior is suspected in the area.

FORAGE

Forage availability is the key factor regulating density of raptor populations (Newton 1979). The high nesting density at Lake Britton and the winter concentration of immatures at Pit 4 Reservoir imply forage conditions for Bald Eagles in the study area are excellent.

Fish

Fish are apparently the primary food source on the study area and are probably utilized year-round, subject to seasonal variation in availability.

A list of fish species found in the study area is presented in Appendix 1.

Waterfowl

Waterfowl provide an important secondary food source during the fall and winter. Bald Eagles were observed attempting to capture American Coots, and castings and feathers found below perch trees indicated foraging includes other species. The numbers and species of waterfowl vary considerably from week to week as migrants pass through the area. At Lake Britton, daily waterfowl numbers during the fall and winter months varied from 100 to about 500, with peaks in late December and again in late January. American Coots were most abundant during October, November, and December.

A list of waterfowl species occurring on the study area is included in Appendix 2.

Forage Ranges

Foraging eagles perched and in flight were observed repeatedly. Birds were observed carrying prey into nest territories and returning to forage areas. These observations were used to partially delineate the forage ranges of each pair. Areas of apparent overlap existed as well as areas of no observed overlap.

HUMAN DISTURBANCE

For the purposes of this study, a "disturbance" consisted of a change in an eagle's immediate behavior in response to a human stimulus. Usually this change was visible in one of two ways: 1) The bird flushed from a nest or perch. If near the nest, the bird sometimes circled and called. In forage or loafing locations, the bird usually flew away from the stimulus. 2) The bird suddenly varied its flight pattern or cut short an attempt to forage and flew away from the stimulus.

All human disturbances of Bald Eagles observed during this study were described in field notes. Distance between the stimulus and the bird was estimated visually and checked by map measurement. (These distances are not as accurate as if measured by rangefinder, and caution should be used in their comparison.) Fifty-four instances of disturbance were observed (Table 2). In over 80% of these cases, the researcher was the stimulus. All of the other disturbances observed were caused by recreationists.

TABLE 2
PIT 3, 4, 5 BALD EAGLE STUDY
OBSERVED HUMAN DISTURBANCES OF BALD EAGLES

Human Activity	Number of Disturbances Observed	Range of Flushing Distances	Mean Distance
Foot traffic	23	<50 - 800 yds.	278 yds.
Vehicle	16	50 - 700 yds.	219 yds.
Boat	3	100 - 400 yds.	250 yds.
Shooting	4	100 - 500 yds.	350 yds.
Helicopter[1]	7	200 - 500 yds.	243 yds.
Trail bike	1	450 yds.	

[1]Elevation 300-500 feet above trees. Horizontal distance estimates are very rough.

Within all disturbance types, occasions were observed when similar stimuli within similar distances caused no recognizable disturbance. This points out the extreme variability of the birds and their reactions at given times.

Forty-six of the observed disturbances were of birds in foraging/loafing behaviors. Disturbance of this behavior mode did not appear to be at a serious level, except during a very few periods of high recreation use. During these periods, adults and fledgings were apparently prevented from using a regular forage area by human activity near Dusty Campground.

The remainder of the disturbance stimuli were observed in nesting primary zones. All of these disturbances were caused by researchers. Judging from behavior observed during and subsequent to these incidents, none were believed to be serious.

In addition to those observed and described, other disturbances may have been important at Lake Britton. In April 1979, four-wheel drive and trail bike tracks were found in the primary zone of territory 10. They were believed to have been made within 24 hours of the abandonment of nesting. In the same month, vehicle tracks found about 100 yards (90 m) from nest 09 were made within two days of abandonment of nesting. Although disturbance could not be confirmed as the causal agent in these cases, their timing was highly coincidental with the failures, and they occurred near the time of hatching, a sensitive point in the reproductive cycle.

Nest-site Switching

Bald Eagles are known to have alternate nests in both disturbed and undisturbed situations. Thelander (1973) documented a gradual retreat of Bald Eagle nest locations in response to human intrusion at Eagle Lake, California.

There are five abandoned nest locations at Lake Britton and at least one at Pit 4 Reservoir. In each case the abandoned nests have been subjected to known disturbances or are in more disturbance-prone locations than the presently-occupied nests. It seems likely that past disturbance levels have resulted in nest-site switching in the study area.

Shooting

Shooting appeared to present the highest potential for disturbance. In 1973 an adult was shot in nest territory 10. No instance of eagles being shot was discovered during the study. Shooting by waterfowl hunters and "plinkers" was observed to disturb perched eagles.

Off-road Vehicles

ORV's were a serious potential source of disturbance. The Lake Britton area contains many roads, from which access to every Bald Eagle nest territory can be attained. Most roads are passable only by four-wheel drive vehicles or motorcycles during the winter and spring. Several temporary closures were bypassed by vehicles before and during the study period. A map of critical road locations was supplied to the Hat Creek Ranger District and the Shasta-Trinity Forests Resource Officer in December 1979. Road closures were initiated and planning for others is underway. Several of these roads are on PG&E and private lands, where no closures have yet been initiated.

Campgrounds

PG&E's North Shore Campground has the highest potential as a disturbance source. Trails from the campground lead into the primary zones of two territories (10 & 29).

The USFS Dusty Campground does not present a direct threat to nesting territories, but human activities here do affect foraging eagles.

The State Park Campground at Burney Falls affects no present nesting locations. There are several foraging perches on the park. One of these, used particularly in winter, is adjacent to the boat ramp road, and birds are often disturbed by vehicles at this point.

Five preferred perching and foraging areas on the eastern portion of Lake Britton all on PG&E lands were affected by recreation use at undeveloped locations. These areas provided occasional camping, fishing, and shooting.

Hiking

Only a small amount of hiking by recreationists was observed, mostly in connection with hunting. But the high number of disturbances observed in response to researchers afoot indicates that Bald Eagles are highly sensitive to this activity. Other studies (Stalmaster 1976, Steenhoff 1976) have affirmed this sensitivity. Planning is presently underway for the Pacific Crest Trail through the study area, and nesting and foraging areas may be potentially affected. The Hat Creek Ranger District is coordinating with CDFG and USFWS on this matter.

Boating

Existing levels of boat use did not appear to significantly affect eagles. Three disturbances observed were caused by small fishing boats. The presence of ski boats was not observed to flush birds, but may have temporarily inhibited forage attempts. The affect by boats might be more serious at times when there are young in the nests at territories 10 or 29, because forage areas for these pairs receive heavier boat use than other areas.

Timber Management

Timber management activity including sale planning, flagging, marking, logging, hauling, and clean up, was underway near Lake Britton during the study period. Due to careful planning by the agencies, no disturbance of Bald Eagles was known to result. In several cases information developed by this study was used in the planning process.

Mining

No development of the proposed mining activities took place during the study. Consequently no disturbance was caused. Potential effects are covered in the discussion section.

In early December 1979, Bald Eagles in nest 29 were flushed by the author afoot near the proposed Grefco rail route. The distance was about 1/4 mile (.4 km).

Residences

Although the presence of residences does not necessarily imply disturbance of eagles, the potential for disturbance is present. The prolonged absence of the adults which foraged at Clark Creek reduced disturbance opportunity, and no disturbances were observed there. Vegetative buffers prevent view of the foraging area from the residence sites.

The private lots between Cayton Creek and Highway 89 abut an important Bald Eagle perching area. Development there could affect eagles in the future.

Law Enforcement

Enforcement personnel from McCloud Ranger District and CDPR issued several warnings to road closure violators in the North Shore area during the study period. The PG&E campground is patrolled regularly, as is the State Park. On the remainder of Lake Britton, there was very little patrol or enforcement effort.

DISCUSSION

With 16% of California's breeding birds and the state's densest nest territories, Pit 3, 4, and 5 Bald Eagles form an important component of California's remnant Bald Eagle population. To maintain this population, suitable nesting, foraging, and roosting habitat should be accounted for in a management plan.

Populations of long-lived, slow-breeding species such as Bald Eagles are known to respond poorly to environmental change (Johnson 1978). Since survival rates are difficult to determine, we actually have little knowledge of the status and stability of populations (Grier 1979).

HABITAT COMPONENTS

The least understood of habitat components is forage. Fish species composition studies, and biomass quantification would add greatly to the understanding of Bald Eagle requirements.

Productivity responses to variations in forage are known among other raptors (Johnson 1978). The condition of female raptors is known to affect reproductive success (Newton 1979). Until more is known about Bald Eagle forage requirements and the existing Lake Britton fish population, modification of the fishery would be imprudent.

Silvicultural prescriptions offer great promise for Bald Eagle nesting habitat, and the Hat Creek Ranger District is a leader in this field. Continued analysis of the remaining territories and application of timber management techniques to maintain nesting habitat over time and space must continue. Analysis should include lands under private, state, and PG&E ownership as well as those of the USFS.

Characteristics of winter roost habitat are poorly understood. Research by Oregon State University on microclimate factors and timber stand characteristics is under way at major roosts in northern California. The observed winter night roosting in nest territories adds a new dimension to silvicultural management efforts. Until night roost areas are better understood, they should not be

modified. Possible roosting near Pit 4 Reservoir and in the USFS Bald Eagle habitat management unit at Lake Britton needs to be defined before timber is harvested.

SEASONAL PRESENCE

The presence of Bald Eagles in and around nest territories during all seasons raises new questions. In the past, some management activities were allowed in protection zones from August to December. The effect of nest-territory disturbances during the non-breeding season is unknown. Autumn or winter activities should be preceded by observation to determine if birds are using the area. Long term intrusions into eagle territories such as construction or logging need to be appraised and monitored.

DISTURBANCE

Disturbance represents a potent variable in successful Bald Eagle management.

A key point was noted in a study by Fraser et al (1979) on the Chippewa National Forest. In an experiment in which nesting Bald Eagles were intentionally disturbed, it was found that instead of growing more tolerant the birds grew less tolerant, and exhibited disturbance behavior at greater distances. Stimuli currently tolerated by Bald Eagles may become intolerable in the future.

To maintain reproductive rates and survival rates in the study area, the level of nest-site disturbance needs to be maintained at a low level and the current low level of foraging disturbance maintained. In an eagle population the size of California's, each nestling represents over 1% of the year's potential production.

Nest-site switching is another problem that may be caused by disturbance. A certain amount of this behavior will occur naturally, but to avoid future planning problems we need to prevent switching as virtually any move made by eagles at Lake Britton at this time could result in conflicts with ongoing or proposed activities.

Disturbance of foraging eagles, while not believed to be serious at this time, should be monitored. Human activities in preferred habitat may force birds to concentrate in less favorable habitats and thus lower carrying capacity of the area (Stalmaster 1976). Poor foraging success may result in lower thrift and subsequent lower reproductive success and juvenile survival (Newton 1979). Forage concentration points such as Pit 4 Reservoir should be protected from disturbance to ensure survival of juveniles and immatures.

Other studies (Stalmaster 1976, Steenhoff 1976, Fraser et al 1979) have observed ranges of disturbance distance similar to those observed in this study. High visibility increases disturbance distances. Opportunities may exist to improve vegetative screening of nest and forage areas. In general, buffer zones of up to 875 yards (800 m) are recommended to reduce visibility.

The Grefco Railroad Proposal

It is my opinion the Grefco railroad route as presently planned would impact the Bald Eagle population as follows: 1) Possible short-term loss of reproduction

in territories 10 and 29 as a result of disturbance during the construction period. Consequences to the state's population are conjectural but potentially serious, since 5% of the state's yearly reproduction could be affected. 2) Possible switching of nest sites due to disturbance during construction and operation. Potential alternative sites are limited, especially in territory 10. A possible alternate nest site might be the abandoned nest, which is highly visible from a number of points on the water and shore. In 29, the best alternate nest habitat is also close to the railroad route. Other potential habitat is on private land. 3) Loss of potential future habitat in the two territories by elimination of timber-producing land. 4) Loss of existing and potentially suitable nesting and winter roosting habitat by creation of a disturbance corridor. 5) Short and long term effect on forage area at Clark Creek during constuction and operation.

From an eagle management point of view, the ideal route would cross the lake at the Sierra Pacific ferry location. This would keep human uses concentrated on the opposite side of the lake from the eagles, rather than encircling the birds.

RECOMMENDATIONS

Increase patrol and enforcement, especially during sensitive periods in eagles' nesting cycle and periods of high human use. Monitor disturbance emanating from North Shore Campground. If indicated, consider nest guard system.

Continue to monitor reproductive success. Coordinate observations to reduce possible disturbance.

Expand analysis of nest habitat to include all of Lake Britton. Where feasible, apply silvicultural techniques to maintain long-term habitat.

Conduct fishery population study and relate to Bald Eagle nesting density.

Continue program of road closures in sensitive areas, including PG&E lands.

Quantify recreation levels for assessment of future trends.

Institute public education program on Bald Eagles in local school system, etc.

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APPENDIX 1
FISH SPECIES OF THE PIT RIVER SYSTEM

The following species are known from the Pit River system and probably occur on the study area, with the exception of the Arctic Grayling.

N = Native I = Introduced R = Rare

N	brook lamprey	I	mosquitofish
I	brook trout	I	black crappie
I	brown trout	I	green sunfish
NR	redband trout	I	bluegill
N	rainbow trout	I	redear sunfish
I	Arctic grayling	I	largemouth bass
I	golden shiner	I	smallmouth bass
N	hardhead	N	tule perch
N	Sacramento squawfish	NR	rough sculpin
NI	tui chub	N	Pit sculpin
N	California roach	N	marbled sculpin
N	speckled dace	NR	Modoc sucker
N	Sacramento sucker	I	brown bullhead

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APPENDIX 2

WATERFOWL SPECIES - PIT 3, 4, 5 AREA

Key: 1. Breeds on study area
2. Migrant or wintering
3. Regular occurrence
4. Uncommon occurrence
5. Occasional occurrence probable but not observed during study

Common Loon - 2,4
Pacific (Arctic) Loon - 2,4
Red-throated Loon - 2,4
Red-necked Grebe - 5
Horned Grebe - 2,4
Eared Grebe - 2,3
Western Grebe - 2,3
Pied-billed Grebe - 2,3
Whistling Swan - 2,4
White-fronted Goose - 2,4
Snow Goose - 2,5
Ross Goose - 2,5
Canada Goose - 1,2,3
Wood Duck - 1,4
American Wigeon - 2,3
Gadwall - 2,4
Pintail - 2,4
Cinnamon Teal - 5
Blue-wing Teal - 2,5
Northern Shoveler - 2,4
Canvasback - 2,4
Redhead - 2,3
Ring-necked Duck - 2,4
Greater Scaup - 2,4
Lesser Scaup - 2,4
Bufflehead - 2,4
Barrow's Goldeneye - 2,4
Common Goldeneye - 2,4
Hooded Merganser - 2,4
Common Merganser - 1,2,3
Ruddy Duck - 2,3
American Coot - 2,3
Mallard - 1,2,3
Green-wing Teal - 2,4

Sources:

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